Editorial

Occasion setting

Occasion setting plays a critical role in many aspects of human and non-human animal behavior, including tool use, social learning, communication, and in clinical settings with humans. The goal of this special issue is to attract attention to the history and diversity of current research on occasion setting. Occasion setting has a long history within the field of learning and behavior (e.g., see Swartzentruber, 1995; or Bonardi et al. and Trask et al., this issue for reviews). The concept of occasion setting within an experimental analysis of behavior came about with Skinner's rejection of stimulus-response (S-R) psychology (Palmer, 1998; Skinner, 1974). He wrote, "[a] prior [discriminative] stimulus does not elicit the response; it merely sets the occasion upon which the response will be reinforced" (Skinner, 1938). Skinner is referring to an operant response that is reinforced in the presence of a discriminative stimulus, but not in its absence. We can illustrate such a discrimination procedure as XR+/R- where X is the discriminative stimulus and R is a response ("+" refers to when reinforcement is delivered and "−" to when it is omitted). With the design illustrated in this manner it is clear that the presence of reinforcement is not predicted well by cues associated with the response (e.g., bodily-kinesthetic, visual, and auditory). Stimulus X, however, is only present when a response is reinforced and so may resolve the ambiguity (i.e., X+/−). Ambiguity regarding the delivery (e.g., if, when, or where) of a biologically relevant outcome (e.g., reinforcer) is a hallmark of past and current occasion setting procedures.

Sainsbury and Jenkins (1967) introduced a feature-positive discrimination procedure in which a second discriminative stimulus was present on some trials but not on others; a response was reinforced in the presence of a compound stimulus (XA+), but not in the presence of one of its elements (A−). In their procedure, illustrated as XAR+/AR−, the target (A) and cues associated with the response (R) are both present on trials when reinforcement is delivered and when it is withheld. Feature (X), however, is present when the response is reinforced and absent when it is not. Consequently, this procedure can be reduced to X+/−, which represents only a minor variation of a standard discrimination procedure. In a feature-positive procedure, it is possible that X could signal the probability of reinforcement in the presence of A rather than signaling the probability of reinforcement directly. Subsequent research included manipulations to reduce the likelihood that X controls responding directly. Morris (1977) reduced the salience of X, and Looney and Griffin (1978) presented A more proximal than X to the delivery of reinforcement. Both manipulations altered responding to the feature compared to the results of Sainsbury and Jenkins.

In particular, presentation of the feature before the target (i.e., serially) resulted in more responding to the target compared to simultaneous presentations (Looney and Griffin, 1978). Questions remained, however, regarding the role of each stimulus in the production of behavior. Did the feature determine the response form and the target act to release it, or did the feature release the response form determined by the target? These questions were answered by Ross and Holland (1981). They trained feature and target stimuli that elicited topographically different conditioned responses in a Pavlovian serial feature-positive discrimination (XA+/A−). Responding during A that matched the form elicited by X would support the former proposition in the above question, whereas a response that matched the form elicited by A would support the latter proposition. The results supported the proposition that Feature X released (or modulated) the response determined by Target A. Whereas feature-positive refers to a procedure and an effect, the term occasion setting refers to the same procedure and effect, but adds modulation as the mechanism by which responding occurs on XA, but not on A trials. As is clear from Fig. 1, a Google Scholar search for "occasion setting" and "feature-positive discrimination" in the text of published articles reveals an increased interest in both during the past four decades.

An occasion setter is expected to satisfy three criteria. Firstly, control by X must be independent of any direct connection between X and reinforcement. Secondly, X must be encoded separately from A. The presentation of two stimuli (e.g., XA) allows for the possibility of processing a unique configuration of both elements. Occasion setting designs include manipulations to increase perceptual discontinuity (i.e., disrupt configural learning). Lastly, X is expected to modulate responding to a specific target, A. It is still an empirical question whether this modulation is specific to the target (e.g., conditioned stimulus, CS specific), to the outcome (e.g., unconditioned stimulus, US specific), or to the target-outcome relationship (e.g., CS-US specific). Several articles in this special issue consider this question. Research investigating how these properties might differentiate an occasion setter from a traditional CS has revealed effects unique to an occasion setter (i.e., not shared with traditional CSs), which include resistance to extinction (Holland, 1989a,b; Rescorla, 1986a) and selective transfer of modulation (Bonardi and Hall, 1994; Holland, 1985, 1995; Rescorla, 1985). Occasion setters can also function as a CS and as an occasion setter in the same procedure, including as an excitatory CS and in an inhibitory role as a negative occasion setter (Holland, 1984; Jenkins, 1985; Rescorla, 1985). The evidence suggests that occasion setters signal specific
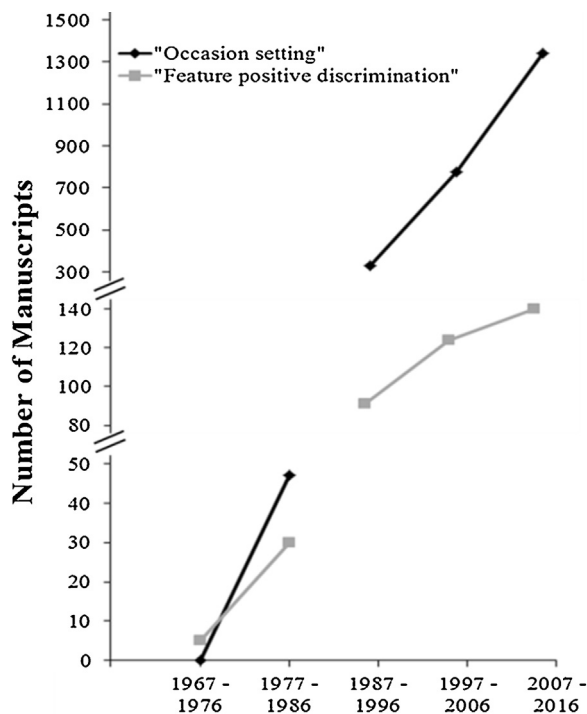
Fig. 1. Results of separate GoogleScholar searches for the terms "occasion setting" and "feature-positive discrimination".

CS-US relationships in much the same manner that CSs signal specific USs. In fact, the same effects reported with a standard CS (e.g., blocking, overshadowing, and latent inhibition) have also been reported with occasion setters (Miller and Oberling, 1998). Much of what we know about Pavlovian processes informs our understanding of occasion setting.

By the late 1990s, there were several theories of how an occasion setter operated on a CS (see Swartzentruber, 1995 and Bonardi et al., this issue for a review). These included Holland's original (Holland, 1983) and revised accounts (Holland, 1989c), Rescorla's account (e.g., Rescorla, 1985), and Pearce's configural account (Pearce, 1987). Researchers have continued to evaluate the theoretical mechanisms involved in occasion setting and investigate the unique properties of occasion setting. This research extends to areas outside of standard conditioning procedures. For example, research in the last decade on the neurobiology (e.g., hippocampus) and therapeutic implications (e.g., extinction, renewal, etc.) of contextual control of fear conditioning are evidence that research on occasion setting (as contextual control) is flourishing (Bouton, 2004, 2010; Corcoran and Maren, 2004; Holland and Bolton, 1999; Yoon et al., 2011). Current research on occasion setting is occurring in psychology with non-human animals (e.g., Bonardi et al., 2012; Brembs and Wiener, 2006; González et al., 2012) and humans (e.g., Declercq and De Houwer, 2009; Fonteyne and Baeyens, 2011; Milad et al., 2005; Rosas and Callejas-Aguilera, 2006), as well as in research investigating substance abuse (e.g., Lattal, 2007; MacLeod et al., 2010; Siegel, 2005; Wilkinson et al., 2009), temporal (e.g., Bonardi and Jennings, 2007; Nakajima, 2009) and spatial (e.g., Collett and Kelber, 1988; Molet et al., 2012; Leising et al., 2015) behavior, computational modeling (e.g., Kutlu and Schmajuk, 2012), and neuroscience (e.g., Bouton and Woods, 2008; Dunn et al., 2005). In the human literature, occasion setting effects and mechanisms are studied as conditional discriminations (or conditional learning).

The articles in this special issue may be categorized broadly into theoretical analysis and characteristics of occasion setting, and

include evidence from a variety of species. With regard to theoretical analysis, Bonardi et al. (this issue) present the rationale and review the literature on extended hierarchical and extended configural accounts of feature-positive discrimination performance. They argue that the key to dissociating the two is to focus on their differing assumptions – in particular whether the occasion setter is qualitatively identical in its action to a CS (configural view) or not (hierarchical view). Bonardi et al. present a review of the evidence and conclude that occasion setters do not summate as CSs do, thereby supporting an extended hierarchical account. In contrast, Vogel et al. (this issue) simulate feature-positive discrimination performance by extending a configural account, the replaced elements SOP model (Brandon and Wagner, 1998; Wagner and Brandon, 2001), to include a role for common cues. Common cues activate a subset of elements any time a feature is present, including when a feature is paired with a different target. Simulations of the model with common elements extend the predictions of a configural model to include effects previously predicted only by hierarchical models. Another paper directly evaluating theoretical accounts of occasion setting is the contribution from Delamater et al. (this issue). The observation that biconditional discrimination tasks can be more difficult to learn than negative patterning discriminations has been taken as evidence against a configural interpretation of performance. This paper examined the extent to which using differential outcomes influences the relative ease of learning these two types of task. The authors conclude that multiple factors – such as outcome type, configural cue salience and stimulus duration – influence the contribution of elemental, configural, and/or modulatory occasion setting mechanisms in these complex discrimination tasks.

Another group of manuscripts evaluates the characteristics of occasion setting. The first set incorporates common effects in the literature on learning and behavior into an occasion setting procedure. Franssen et al. (this issue) trained humans in a Pavlovian feature-positive (AX+/X−) video game procedure followed by extinction and reinstatement. A prediction unique to reinstatement within occasion setting is that X-US reinstatement should be more effective than US-only exposures. However, reliable reinstatement was found after US-only exposures and not after X-US exposures. Reliable transfer of occasion setting after X-US reinstatement was also not observed, but during this procedure Franssen et al. provide evidence of secondary extinction within occasion setting. An article by Trask et al. (this issue) reviews the evidence that the renewal effect in Pavlovian conditioning is best explained by an occasion-setting mechanism, but argues that the same analysis cannot be applied to operant renewal. They review the results of a series of experiments suggesting that the context accompanying extinction of an operant response transfers only poorly to other responses. They argue that this marked lack of transfer seen in the instrumental case is not consistent with an occasion-setting interpretation, and instead propose that the context inhibits the response directly.

The remaining manuscripts represent attempts to use occasion setting procedures to study different aspects of behavior. Rayburn-Reeves et al. (this issue) analyze how time within a session and discrete color cues inserted in the intertrial interval could serve as occasion setters to signal a switch in the reinforced response to a target stimulus in a mid-session reversal task with pigeons. Transfer tests were used to determine whether the cues would operate independently or interact. Rayburn-Reeves conclude that the influence of the discrete cue (color during the inter-trial interval) on behavior was dynamically altered by the presence of the diffuse cue (time in session). Cleland et al. (this issue) investigated how spatial uncertainty regarding where a response is reinforced relative to a mobile landmark resembles conventional occasion setting. After training, transfer with pigeons was tested by pairing an occasion setter with a landmark that had been previously modulated,